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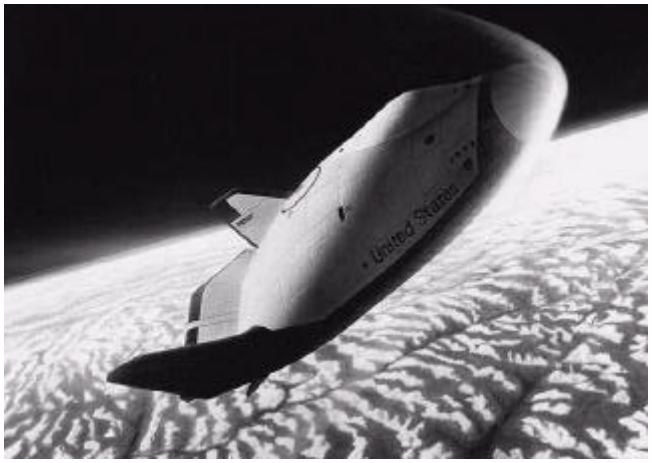
The X-38: *Back to the Future For a Spacecraft Design*



Turn of the Century Spacecraft: The X-38, a new human spacecraft being designed at the Johnson Space Center for use as a crew return vehicle, or lifeboat, for the International Space Station, is shown in the artist's concept above as it reenters the atmosphere. Below, the first of three unpiloted atmospheric flight test vehicles for the X-38 goes through a "captive carry" flight test where it remains attached under the wind of a NASA B-52 aircraft at the Dryden Flight Research Center in fall 1997. An unpiloted space test vehicle also is being built at JSC for a shuttle flight at the turn of the century.

NASA engineers at JSC are designing and flight-testing a prototype spacecraft that could become the first new human spacecraft to travel to and from orbit in the past two decades, a spacecraft developed at a fraction of the cost of past human space vehicles.

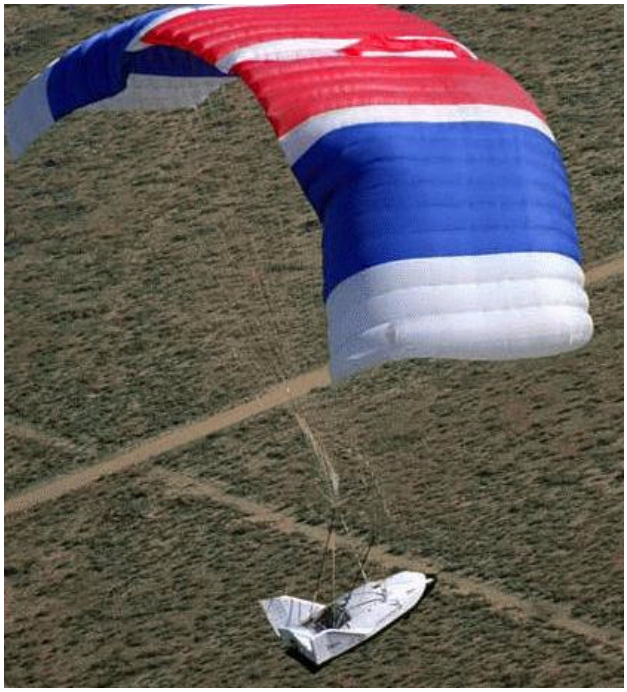
The most immediate application of the innovative project, designated the X-38, is to develop the technology for a prototype emergency crew return vehicle (CRV), or lifeboat, for the International Space Station. But the project also is aimed at developing a crew return vehicle design that could be modified for other uses, such as a possible joint U.S. and international human spacecraft that could be launched on the French Ariane 5 booster. And the goal is to develop the vehicle with an unprecedented eye toward efficiency, taking advantage of available equipment and already developed technology for as much as 80 percent of the spacecraft's design.

"Using available technology and off-the-shelf equipment can significantly reduce costs," said X-38 Project Manager John Muratore. "Some estimates to build a capsule-type CRV several years ago amounted to more than $2 billion in total development cost. The X-38 concept could develop and build four operational CRVs, vehicles that are more capable and versatile than earlier designs, for less than a quarter of that."

In the early years of the International Space Station, a Russian Soyuz spacecraft will be attached to the station as a CRV. But, as the size of the crew aboard the station increases, a return vehicle like the X-38 that can accommodate up to six passengers will be needed.

The X-38 design uses a lifting body concept originally developed by the Air Force's X-24A project in the mid-1970s. Following the jettison of a deorbit engine module, the X-38 would glide from orbit unpowered like the Space Shuttle and then use a steerable, parafoil parachute, a technology recently developed by the Army, for its final descent to landing. Its landing gear would consist of skids rather than wheels.

"Just because it is off-the-shelf technology doesn't mean it is old technology. Many of the technologies we are using have never before been applied to a human spacecraft," Muratore said. "We are out to prove that we



Flying Parachute: *Flight tests of the 5,500 square-foot parafoil and the X-38 lifting body are being carried out at the Dryden Flight Research Center, Ca. The unpiloted tests began in March 1998 and will involve three increasingly complex atmospheric flight test vehicles flying from up to 50,000 feet to touchdown during 1998 and 1999. With a wingspan of 121.5 feet, the parafoil is an expansion of technology first developed and tested by the U.S. Army. An unpiloted space test is set for 2000.*

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can produce a highly versatile human spacecraft for significantly less cost than has ever been done before."

The X-38 flight computer is commercial equipment that is already in use in aircraft, and the flight software operating system is a commercial system already in use in many aerospace applications. The video equipment being used on the atmospheric test vehicles is existing equipment, some of which has already flown on the Space Shuttle for other NASA experiments. The electromechanical actuators that are used on the X-38 come from a previous joint NASA, Air Force and Navy research and development project. A special coating that had already been developed by NASA is planned to be used on the X-38 thermal tiles to make them much more durable than the tiles used on the Space Shuttle. The X-38's primary navigational equipment, the Inertial Navigation System/Global Positioning System, is a unit already in use on Navy fighters.

Although the design could one day be modified for other uses such as a crew transport vehicle, the X-38 would strictly be used as a CRV in its current design. It is baselined with only enough life support supplies to last about nine hours flying free of the space station in orbit. The spacecraft's landing will be totally automated, although the crew will have the capability to switch to backup systems, control the orientation in orbit, pick a deorbit site, and steer the parafoil, if necessary. The X-38 CRV has a nitrogen gas-fueled attitude control system and uses a bank of batteries for power. The spacecraft will be 28.5 feet long, 14.5 feet wide and weigh about 16,000 pounds.

A small, in-house development study of the X-38 concept first began at JSC in early 1995, and, in the summer of 1995, early flight tests were conducted of the parafoil concept, dropping platforms with a parafoil from an aircraft at the Army's Yuma Proving Ground, Yuma, Arizona. Early in 1996, a contract was awarded to Scaled Composites, Inc., of Mojave, California, for the construction of three full-scale atmospheric test airframes. The first vehicle airframe was delivered to JSC in September 1996, where it was outfitted with avionics, computer systems and other hardware in preparation for drop tests at the Dryden Flight Research Facility, Edwards, California. A second and third vehicles are being manufactured in California and outfitted at JSC in a similar manner.

Full-scale, unpiloted flight tests began in the fall of 1997 at DFRC with "captive carry" flights in which the first atmospheric test vehicle remained attached to the NASA B-52 aircraft. Free-flight drop tests, also unpiloted, from the B-52 began in March 1998 with the first vehicle. Drop tests will continue with the three test vehicles increasing from an altitude of 23,000 feet to 50,000 feet during 1998 and 1999.

Further testing will include an unpiloted space flight test deployed form a Space Shuttle mission in 2000, and the new CRV could be attached to the International Space Station by 2002. It is estimated that the total projected cost of the X-38's development through the completion of two space test vehicles could be less than $90 million.

About 100 people are currently working on the project at JSC, at DFRC and at the Langley Research Center in Hampton, Va. This is the first time a prototype vehicle has been built-up in-house at JSC, rather than by a contractor, an approach that has many advantages.

"By building this ourselves, we are going to have a better understanding of the problems contractors experience when they build vehicles for us, and we will have a detailed set of requirements for the contractor. Using civil servants is among the most efficient ways to perform a small project like this, as well," Muratore said. "This gets NASA back to its research and development roots, the type of hands-on work that was done when it was NACA, the National Advisory Committee on Aeronautics, before the space age began."